DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION

E1NM
Revision 3
AlliedSignal Inc.
TFE731-20
TFE731-20AR
TFE731-20R
TFE731-40
TFE731-40R
TFE731-60

May 14, 1999

TYPE CERTIFICATE DATA SHEET NO. E1NM

Engine models described herein conforming with this data sheet (which is part of Type Certificate No. E1NM) and other approved data on file with the Federal Aviation Administration, meet pertinent aircraft data sheets and applicable portions of the Federal Aviation Regulations provided they are installed, operated, and maintained as prescribed by the approved manufacturer's manuals and other approved instructions.

Type Certificate Holder: AlliedSignal Inc.
111 South 34th Street
Phoenix, AZ 85034

Model: **TFE731-20, -20AR, -20R, -40, -40R, and -60**

Type: Turbofan: One stage geared fan, four stage axial flow low pressure compressor, one stage centrifugal high pressure compressor, annular combustor, one stage high pressure turbine, and three stage low pressure turbine.

Static Thrust Ratings:

TFE731 Models	Max. Continuous at Sea Level, lbs.	Takeoff at Sea Level, lbs. (5 mins.)
-20	3500	3500
-20AR	3500	3650
-20R	3500	3650
-40	4250	4250
-40R	4250	4462
-60	4525	5000

Controls. Fuel controls and power management are controlled by a Digital Electronic Engine Control (DEEC) with a backup hydromechanical control. The hardware and software configurations of this system and the associated engine fuel pump and hydromechanical unit are controlled by an approved engine equipment list for each specific engine model and aircraft application.

Principal Dimensions
Refer to the installation drawing for each specific engine model configuration for dimensions and center of gravity location.

Weight, Dry, Pounds (maximum):

TFE731 Models	Lbs.
-20	895
-20AR	895
-20R	895
-40	885
-40R	885
-60	988

The engine weights shown herein are that of the power section and all components coded "E" in the Engine Equipment List. The total engine weight, including the weight of items coded "A" in the Engine Equipment list, is included on the engine installation drawing for each specific aircraft configuration.

Fuel

Fuels conforming to AlliedSignal Inc. Specifications EMS 53111 (Jet A Type), EMS 53112 (Jet A-1 and JP-8 Types), EMS 53113 (Jet B and JP-4 Types), and EMS 53116 (JP-5 Type).

BIOBAR JF biocide additive is approved for use in the fuel at a concentration not to exceed 20 ppm of elemental boron. KATHON FP 1.5 biocide additive is approved for use in the fuel at a concentration not to exceed 100 ppm.

Shell ASA-3 Anti-Static Additive, or equivalent, in amounts to bring the fuel up to a range of 50 to 450 conductivity units for JET A, JET A-1, and JET B, or up to a range of 200 to 600 conductivity units for JP-4, JP-5, and JP-8, is permissible as long as the quantity added does not exceed one part per million.

MIL-I-27686 or MIL-I-85470 inhibitor, icing, fuel system, or equivalent, are approved for use in fuel in amounts up to 0.15 percent by volume.

Aviation Gasoline, ASTM D 910 Grades 80 or 100LL, not in excess of 500 gallons per 100 hours of operation, may be used in emergencies.

Oil

Oil conforming to AlliedSignal Inc. Specification EMS53110.

Certification Basis

*CFR 14, Part 33, effective February 1, 1965, as amended by 33-1 through 33-14, dated September 10, 1990, with elected compliance to Amendment 15 dated August 16, 1993.

Model	Part 33 Certification Basis	Part 34 Certification Basis	Date of Application	Date of Issuance/Amended
-60	*as stated above	original	2/8/94	5/1/95
-40, -40R	*	original	2/8/94	7/13/95
-20, -20R	*	original	1/19/93	4/4/97
-20AR	*	amended by 34-1 through 34-3	3/24/99	5/14/99

Production Basis

Production Certificate No. 413, issued March 4, 1965.

NOTE 1. Maximum permissible operating speeds for the low and high pressure rotors for all engine models are as follows:

	Low Pressure Rotor (N1) RPM	High Pressure Rotor (N2) RPM
Takeoff/Maximum Continuous	21,000	31,485
Maximum Permissible (control overshoot)	21,105	31,957

NOTE 2. Temperature Limits:

Maximum Interstage Turbine Temperature (ITT) Limits: $^{O}F(^{O}C)$

TFE731 Models	Max. Continuous	Takeoff (5 Mins.)	Starting (Ground/Air)
-20	1,726 (941)	1,726 (941)	1,726 (941)
-20AR	1,726 (941)	1,766 (963)	1,726.. (941)
-20R	1,726 (941)	1,766 (963)	1,726 (941)
-40	1,816 (991)	1,871 (1022)	1,822 (994)
-40R	1,816 (991)	1,871 (1022)	1,822 (994)
-60	1,816 (991)	1,871 (1022)	1,822 (994)

Maximum Oil Inlet Temperature Range, ^{O}F (^{O}C) for all engine models:

	Sea Level to 30,000 Feet	Above 30,000 Feet
Fan Gearbox Inlet Maximum	260 (127)	284 (140)
Accessory Gearbox Inlet Maximum	300 (149)	315 (157)

Fan gearbox oil inlet temperature transient of $300^{O}F$ ($149^{O}C$) for a maximum of 2 minutes is permitted for all operational altitudes.

External engine components, maximum temperature (limiting temperature of specific components) are as specified in the applicable engine installation manual, see NOTE 12.

Operation at an engine fuel inlet temperature as high as 135°F (57°C) with a vapor volume to liquid volume ratio (V/L) equal to 0.45, and as low as -65°F (-54°C) with fuel at a viscosity of 12 centistokes or less during starting is approved.

NOTE 3. Fuel and Oil Pressure Limits:

Fuel pump inlet pressure,	minimum	5 psi above true vapor pressure
	maximum	50 psig
Oil pressure	minimum	50 psig
	normal operating range	65 to 80 psig

NOTE 4. The ratings are based on static test stand operation and under the following conditions:

(a) No loading of accessory drives.
(b) No compressor bleed airflow.
(c) Bellmouth inlet conforming to AlliedSignal Inc. Drawing 5837113 for the TFE731-60 and SKP17308 for the TFE731-20, -20AR, -20R, -40, and -40R.
(d) Fan exhaust and turbine exhaust nozzles conforming to AlliedSignal Inc. Drawing SKP23202 for the TFE731-60 and SKP23199 for the TFE731-40, -40R and SKP23196 for the TFE731-20, -20AR, -20R.
(e) No anti-icing airflow.
(f) Interstage Turbine Gas Temperature (ITT) and rotor speed limits not exceeded.

NOTE 5. Accessory Drive Provisions:

Accessory Drive	Drive Type (one each)	Internal Spline Config.	RPM and Rotation Facing Drive End	Note: (e) Accessory Max. Torque (lb-in)			Weight (pounds, maximum)	Overhung Moment
				Tc	To	Ts	Note (b)	(lb-in)
Starter or Starter Generator D2* Note (c)	AND20002 Type XII-D modified as follows: RPM, torques, accessory weight, and moment as shown	AND20002	12,602 Note (a) CW	200	300	1600	45	400
Aircraft Accessory D3*	AND20002 Type XII-D modified as follows: RPM, torques, accessory weight, and moment as shown	AND20002	12,602 Note (a) CW	200	300	1000	40	400
Aircraft Accessory D1* (for engines without motive flow fuel pump)	AND20001 Type XI-B modified as follows: RPM, torques, accessory weight, and moment as shown	AND20001	6,300 Note (a) CW	240	360	1650	15	100
Aircraft Accessory D1* (for engines with motive flow fuel pump) Note (d)	AND20001 Type XI-B modified as follows: RPM, torques, accessory weight, and moment as shown	AND20001	6,300 Note (a) CW	100	165	1000	7	18

CW= clockwise (looking aft) To = torque overload (5 min. per 4 hr. period)
Tc = continuous torque Ts = static torque

*Accessory pads are identified by these symbols on the applicable installation drawings.

Notes: (a) Drive speeds are based on a maximum steady state HP rotor speed of 31,485 rpm.
(b) Total weight of the aircraft accessories shall not exceed 95 pounds for engines without motive flow fuel pump: 87 pounds with motive flow fuel pump.
(c) The estimated torsional spring constant for the starter generator drive is 7,000 pound inches per radian.
(d) Drive is located on engine auxiliary motive flow fuel pump.
(e) Total combined accessory power extraction limits are specified in the applicable engine installation manual (see Note 12).

NOTE 6. For compressor bleed airflow limits, refer to the applicable engine installation manual (see NOTE 12).

NOTE 7. These engines meet FAA requirements for turbine disk integrity and rotor blade containment.

NOTE 8. These engines meet FAA requirements for operation in icing conditions within the envelope defined in CFR 14 Part 25, Appendix C.

NOTE 9. Certain engine parts are life-limited. These limits are published in the Light Maintenance Manuals, Chapter 5, and referenced in the FAA approved AlliedSignal Inc. Service Bulletin TFE731-72-5101.

NOTE 10. Variations in engine configuration and installation components are identified by a suffix to the basic model number on the engine nameplate, i.e. TFE731-60-XX, and an Engine Equipment List number. Certain features of these components are influenced by aircraft design considerations. In the Engine Equipment List, those items coded "E" are basic engine items and are controlled by Part 33. Items coded "A" have been demonstrated as compatible with the basic engine during engine certification testing. However, operation, functioning, and performance of these in a specific aircraft installation must be demonstrated during aircraft certification. Subsequent design control associated with these factors is the responsibility of the aircraft manufacturer.

NOTE 11 Power setting, power checks and control of engine thrust output in all operations is to be based on AlliedSignal Inc. engine charts referring to low pressure rotor speed (N_1). Speed sensors are included in the engine assembly for this purpose.

NOTE 12. For additional authorized operation and installation detailed information, refer to FAA approved sections of the applicable engine installation manuals as follows:

IM-8300: TFE731-20, -20AR, -20R
IM-8010: TFE731-40, -40R
IM-8009: TFE731-60

NOTE 13. Model description – similarities, differences and special characteristics:

TFE 731-60 Basic Model – One stage geared fan (damperless low-aspect-ratio rotor blade), four-stage axial flow low pressure compressor, one-stage centrifugal high pressure compressor, annular combustor, one-stage high pressure turbine, and three-stage low pressure turbine.

TFE731-40 Same as basic except, one-stage geared fan (midspan dampered rotor blade), different external assembly (plumbing, electrical, etc.).

TFE731-40R Same as TFE731-40 except different external assembly (plumbing, electrical, etc.). The –40R incorporates the Automatic Performance Reserve (APR) system and/or the Manual Performance Reserve (MPR) system.

TFE731-20 Same as basic except, one-stage geared fan (midspan dampered rotor blade), modification to the tangential onboard inducer (TOBI), single crystal material for first-stage LP turbine blade, different HP turbine nozzle area, different combustor and fuel atomizer shroud cooling scheme, different external assembly (plumbing, electrical, etc.).

TFE731-20R Same as TFE731-20 except the –20R incorporates the APR and/or MPR system.

TFE731-20AR Same as TFE 731-40R except different external assembly (plumbing, electrical, etc.).

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